

VI.4.2-OPT3-PATSERCH PROGRAM OPT3 PATTERN SEARCH CONCEPT  
REPRESENTATION

Search of Two Parameter Space (Monro, 1971)

Method

DELTA = parameter increment to be used

MAXN = maximum number of trials allowed before optimization is terminated

MAXR = maximum number of resolution maneuvers allowed before optimization is terminated

ITC = number of trials in which the criterion value must change by DELTA before optimization is terminated

PCNT = percentage by which criterion value must change in ITC trials or MAXR resolution maneuvers

1. The optimization criterion is computed with parameters [A(1), A(2)] at their initial value. The calculated criterion represents the base value.

2. Local Excursion:

A. The initial value of the first parameter A(1) is increased by DELTA. Remaining parameters A(2) are unchanged.

B. The simulation is re-run and a new optimization criterion is computed.

C. If the optimization criterion is now better than the base value, A(1) is held at its new value and the criterion base value is reset to the improved value.

D. If the criterion value is not improved, DELTA is subtracted from the initial value. Steps B and C are repeated. The original parameter is retained if in both cases the estimation criterion was not improved.

E. Steps A-D are repeated until all parameters have been so treated. If the result is an improved criterion, the local excursion is complete.

3. Pattern Move:

A. A pattern move follows each successful local excursion.

B. The pattern move size [PM(i)] for any parameter [A(I)] is computed as follows:

$$PM(i) = N(I) * DELTA(I)$$

$$N(I) = n_1(I) - n_2(I)$$

where  $n_1(I)$  is the number of previous successful (+) local excursions for A(I)

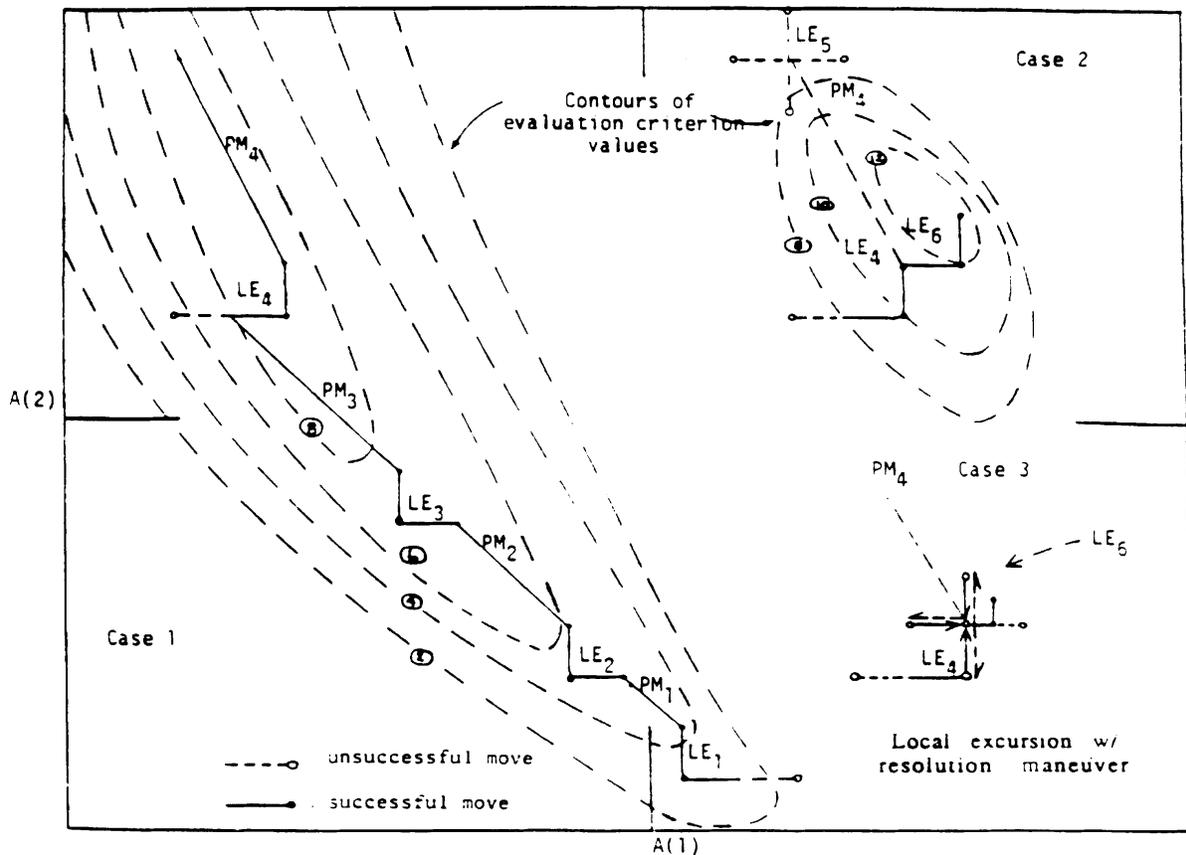
$n_2(I)$  is the number of previous successful (-) local excursions for A(I)

- C. The logic of the pattern move is to increase the size of the increment for each parameter as long as the local excursions for that parameter have shown a persistence of direction.

Optimization is terminated when one of the following occurs:

1. the number of trials exceeds MAXN
2. the criterion value does not change by PCNT in ITC trials
3. optimization is considered complete when DELTA has been halved MAXR times

In the following figure, contours of equal criterion values may represent peaks or valleys. The lowest valley point would be the optimum value of the estimation criterion for a minimization search (the highest peak for a maximization search).



Case 1 - A persistent direction of successful local excursions alternating with increasingly larger pattern moves.

Case 2 - The evaluation criterion is poorer after, than before a pattern move and cannot be corrected by a subsequent local excursion. The old pattern move is abandoned and the algorithm back tracks one cycle, adopting the values of the parameters from the last local excursion. The pattern move increments are reset to their original small values.

Case 3 - A pattern move has been abandoned and the following local excursion does not improve the results. A resolution maneuver is in order. In a resolution maneuver the local excursion DELTAs are halved.

#### References

Monro, J. C., 'Direct Search Optimization in Mathematical Modeling and a Watershed Model Application', NOAA Technical Memorandum NWS HYDRO 12, Silver Spring, MD, 1971.